EXHIBIT “B”

ENGINEER'S REPORT

of the

MCCOY INCIDENT

Prepared by:

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November 4, 2021

THE EXPERTS
Robson Forensic

FIELDMAN INCIDENT

ENGINEER'S REPORT **November 4, 2019**

A. INTRODUCTION

On July 17, 2016 Ishynique McCoy was injured by the explosion of the lithium ion battery within her iPhone 6 Plus that was near her while in her residence 2046 Turner Street, Philadelphia, PA.

The purpose of my investigation was to determine the cause of the explosion which injured Ms. McCoy.

B. MATERIALS AVAILABLE FOR REVIEW

1. City of Philadelphia Fire Department Report of Fire Alarm, 7/17/2016
2. Photographs from Inspection, 7/7/2021
3. Apple Document Production 001-116
4. FedEx Supply Chain Disclosure, Interrogatory Responses, Document Production
5. Deposition of Ishynique McCoy
6. Complaint
7. Philadelphia Fire Department Fire Report

C. BACKGROUND

The incident phone was an iPhone 6 Plus manufactured by Apple with serial number 354387062506228. The incident phone was obtained by Ms. McCoy's mother after her phone was stolen. The phone was received by FedEx Supply Chain on December 30, 2015 and repairs were made by FedEx Supply Chain on January 22, 2016.[1]

Lithium ion polymer batteries are common in mobile devices such as phones and tablets. Construction of a lithium polymer battery cell as described by Apple:

> *"This battery cell includes a jelly roll comprising layers which are wound together, including a cathode with an active coating, a separator, and an anode with an active coating. The jelly roll also includes a first conductive tab coupled to the cathode and a second conductive tab coupled to the anode. The jelly roll is enclosed in a flexible pouch, wherein the first and second conductive tabs extend through seals in the pouch to provide terminals for the battery cell."*[2]

[1] FedEx Supply Chain Interrogatory Responses page 2
[2] United States Patent Application 20110123844 – May 26, 2011 – APPLE INC. – Pressure-Relief Mechanism to Improve Safety In Lithium-Polymer Battery Cells; Background

D. APPLE DOCUMENT PRODUCTION

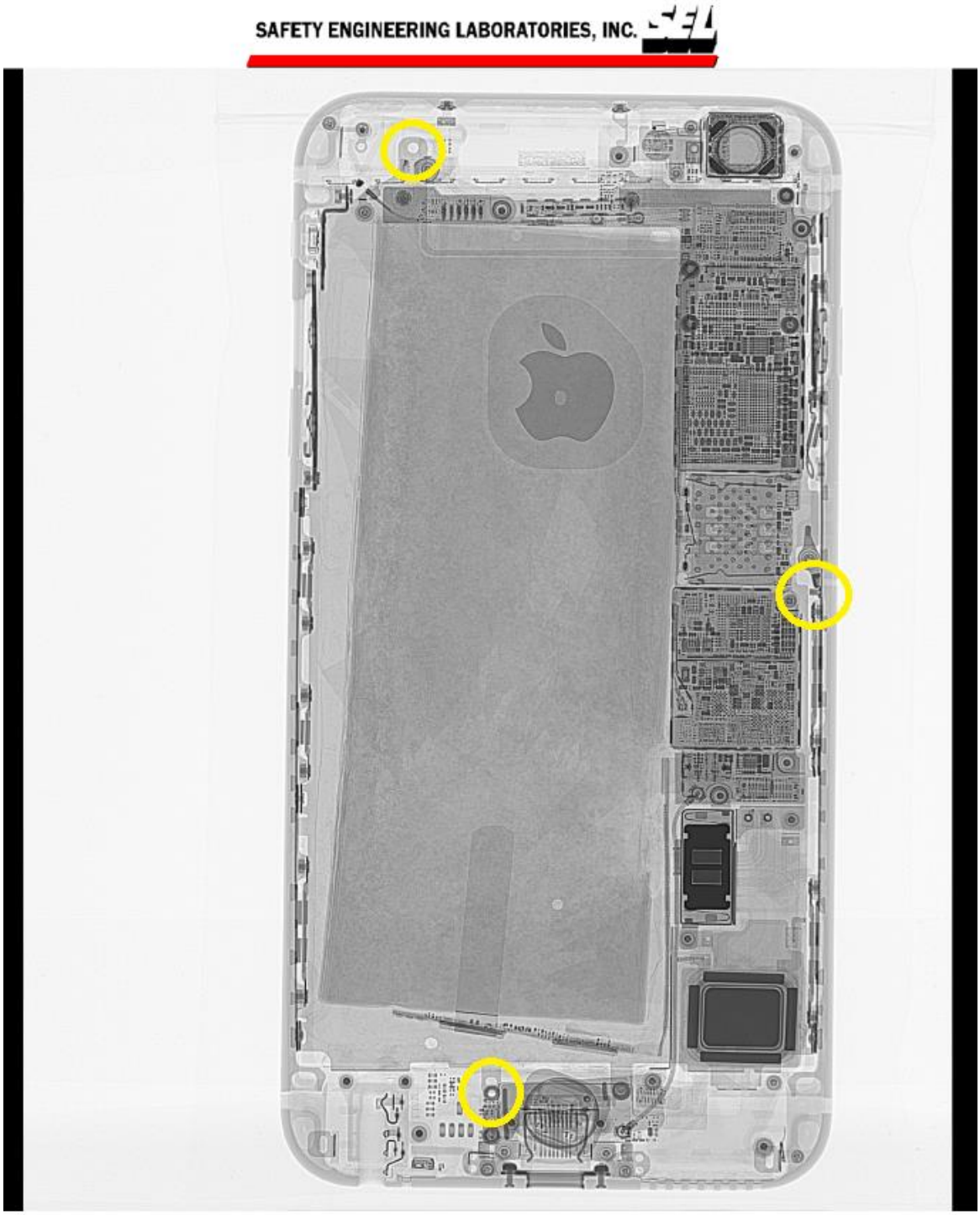

Figure 1- Missing screws and loose screw circled in yellow.

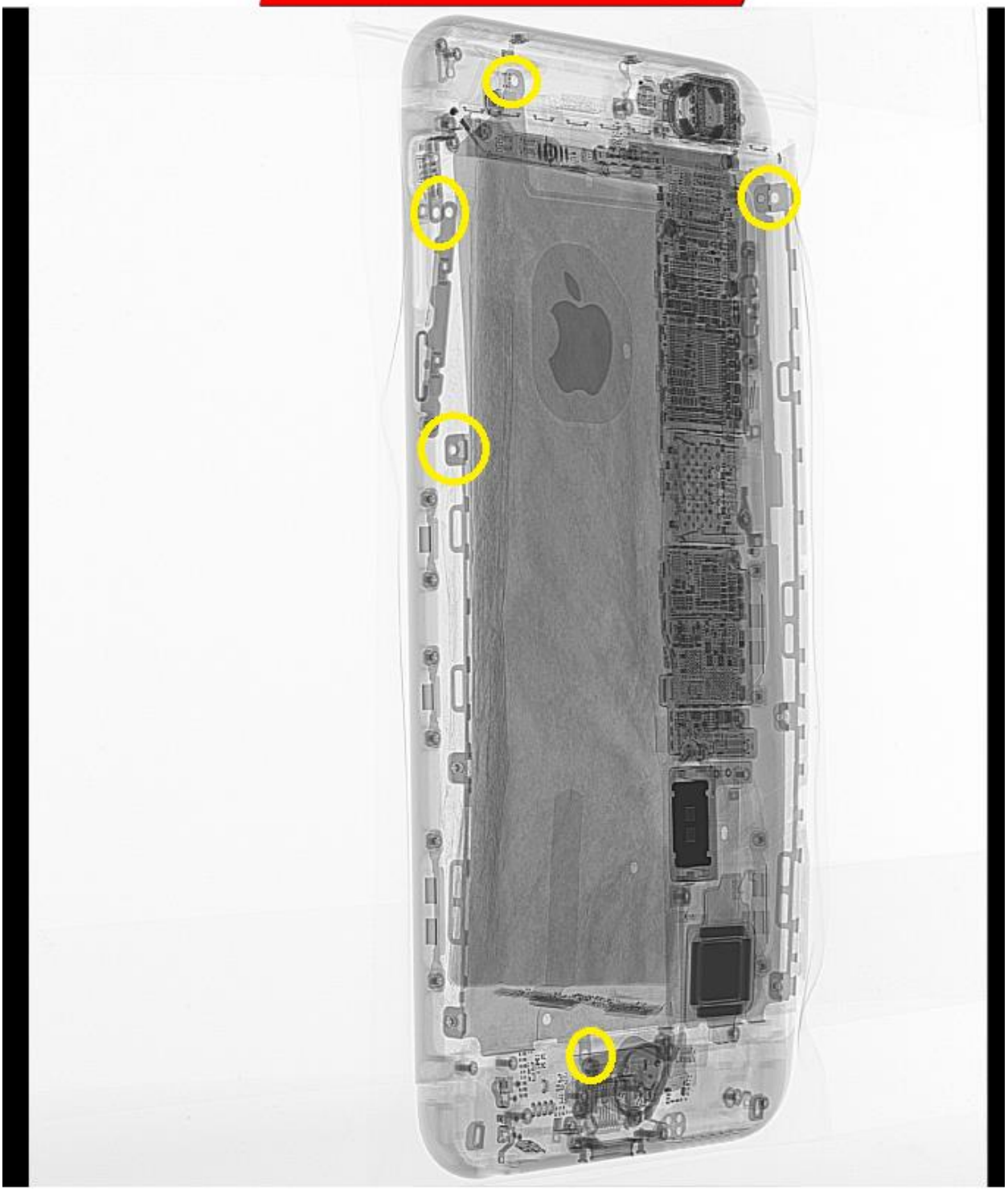

Figure 2 - Missing Screws circled in yellow

Figure 3 - Damage from internal pressure and heat, missing screws

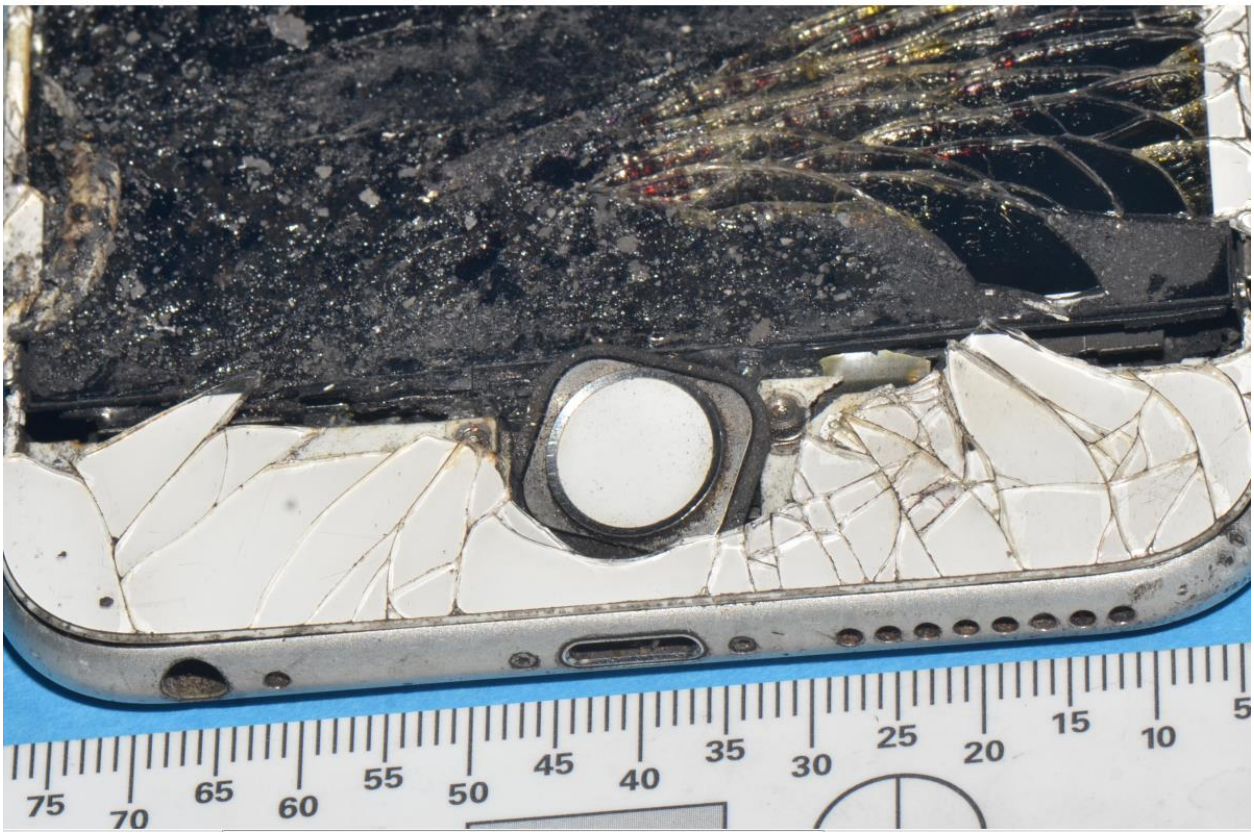

Figure 4 - Significant damage near lower half of the screen

Figure 5 - Missing screws, screen pushed upward from battery cell expansion

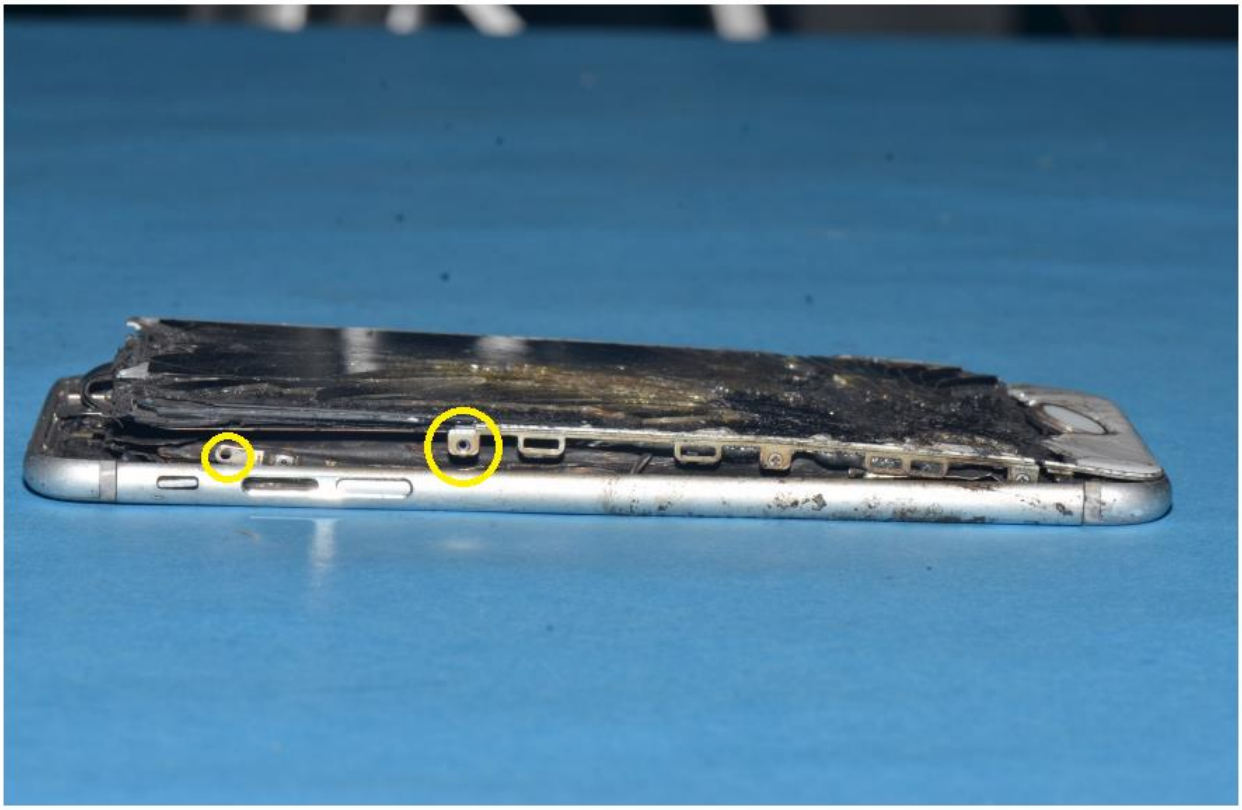

Figure 6 - Missing screws, screen pushed upward from battery cell expansion

Figure 7 - Back cover of incident phone

E. EVIDENCE EXAM PHOTOGRAPHS, 07/07/2021

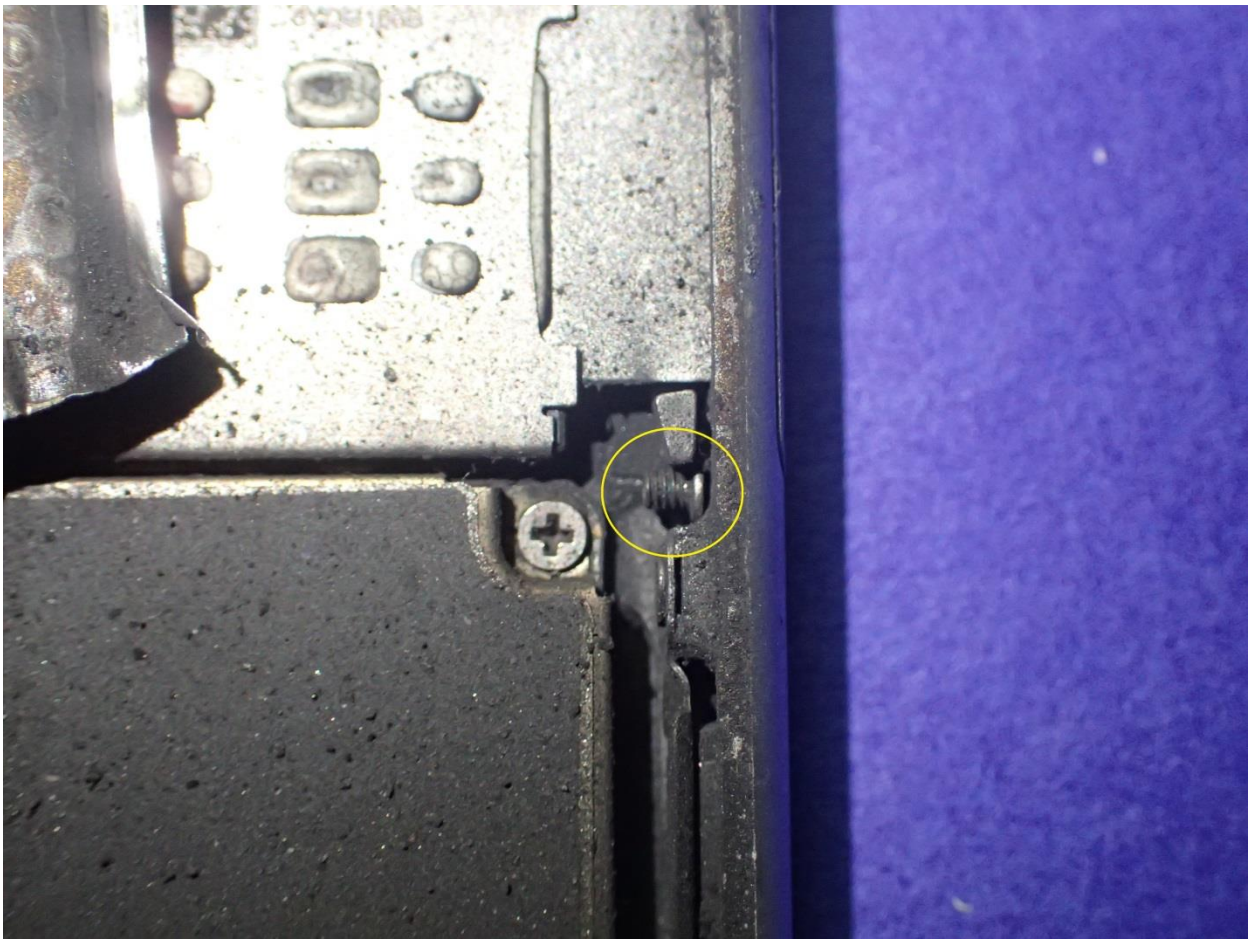

Figure 8 - Loose screw inside incident phone

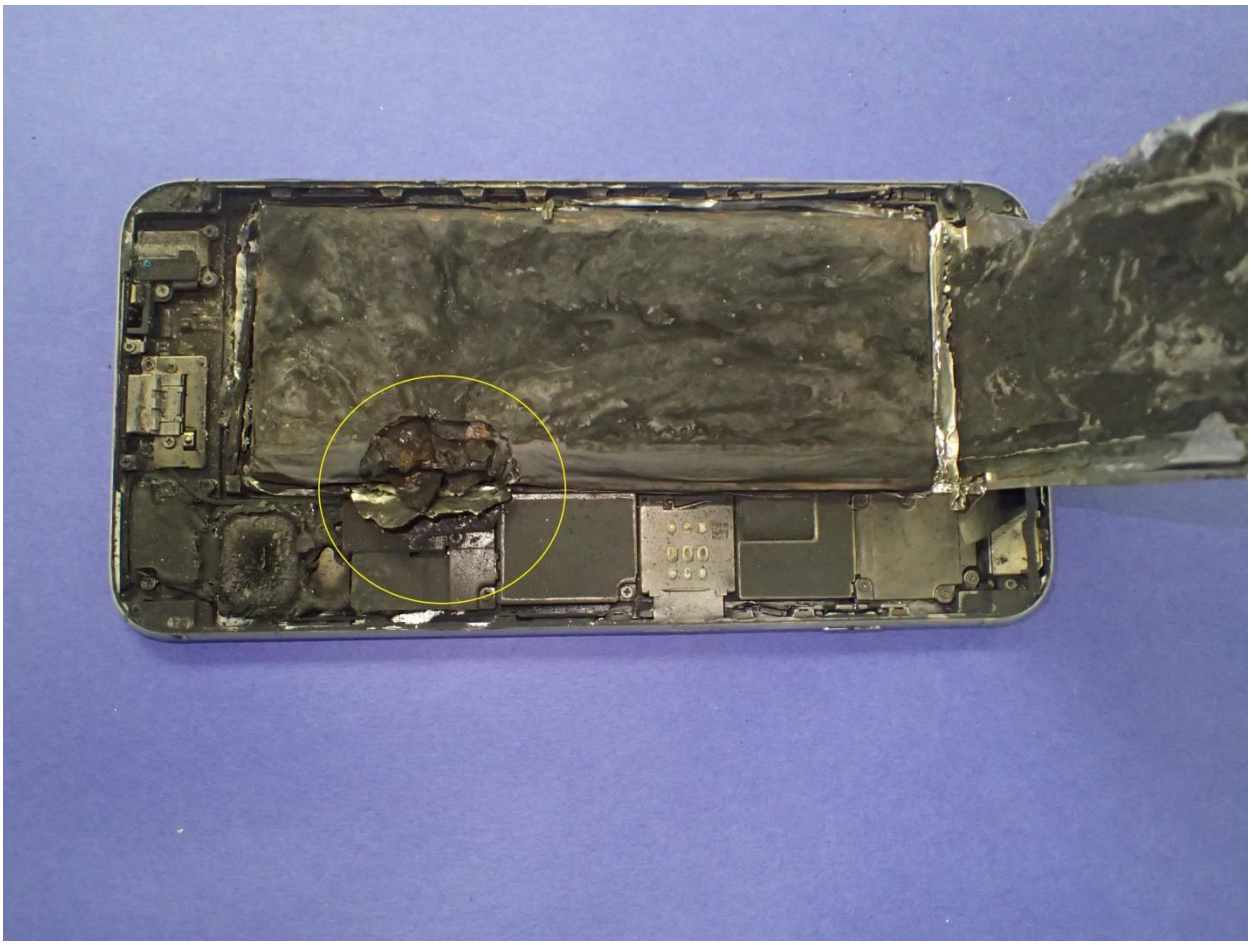

Figure 9 - Incident phone battery cell side rupture

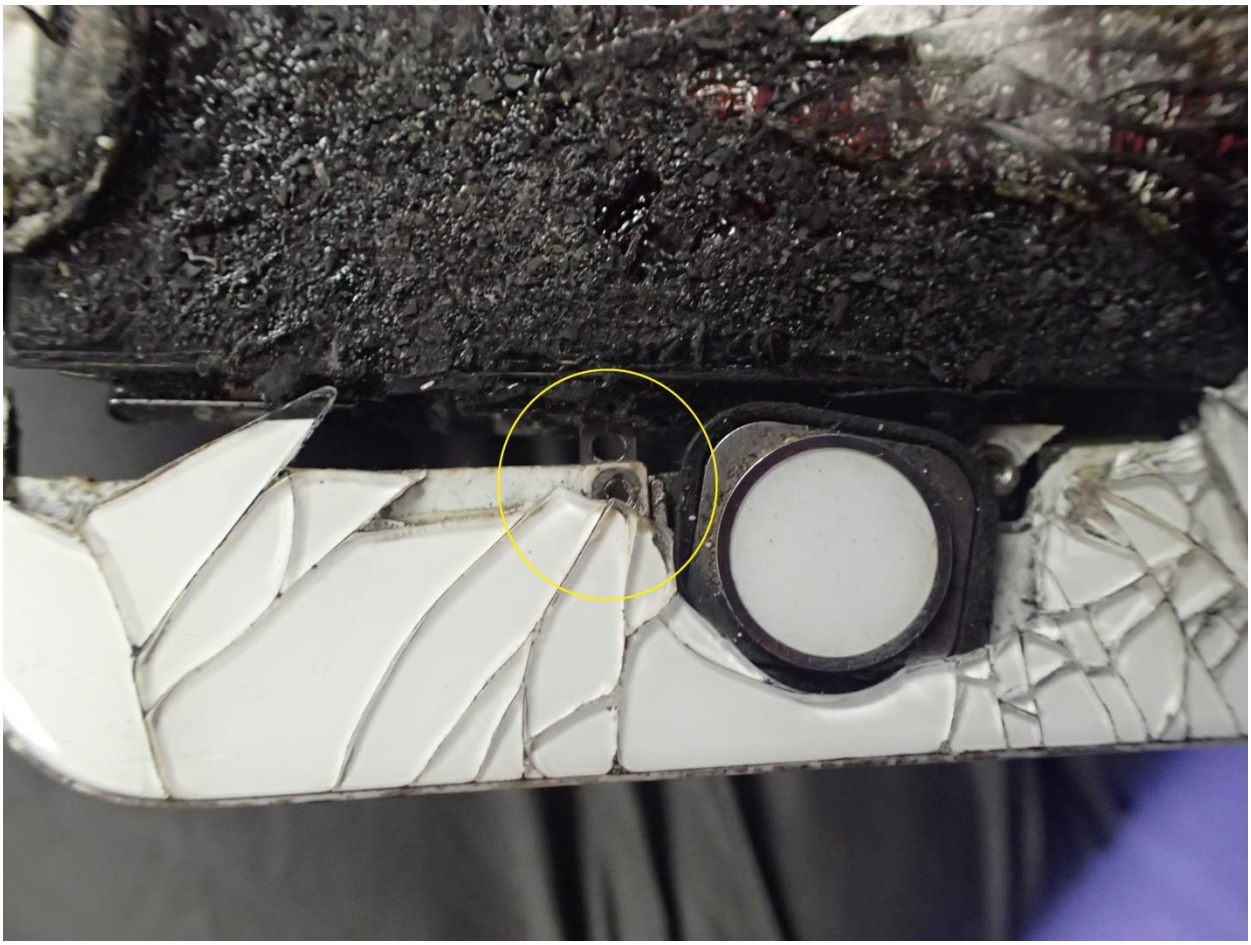

Figure 10 - Missing screw near home button

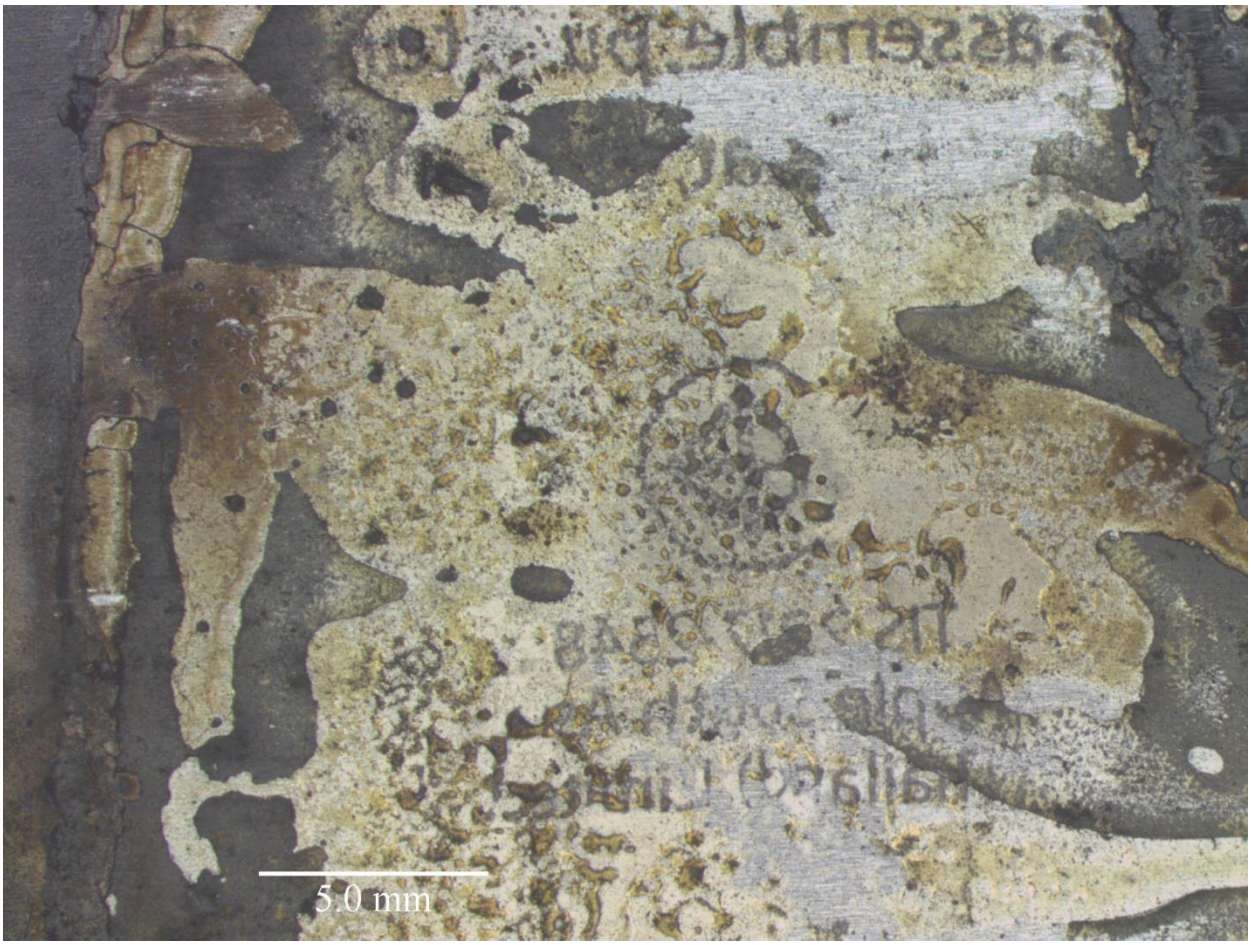

Figure 11 - Battery Label transferred to mid-plate - "Apple South Asia"

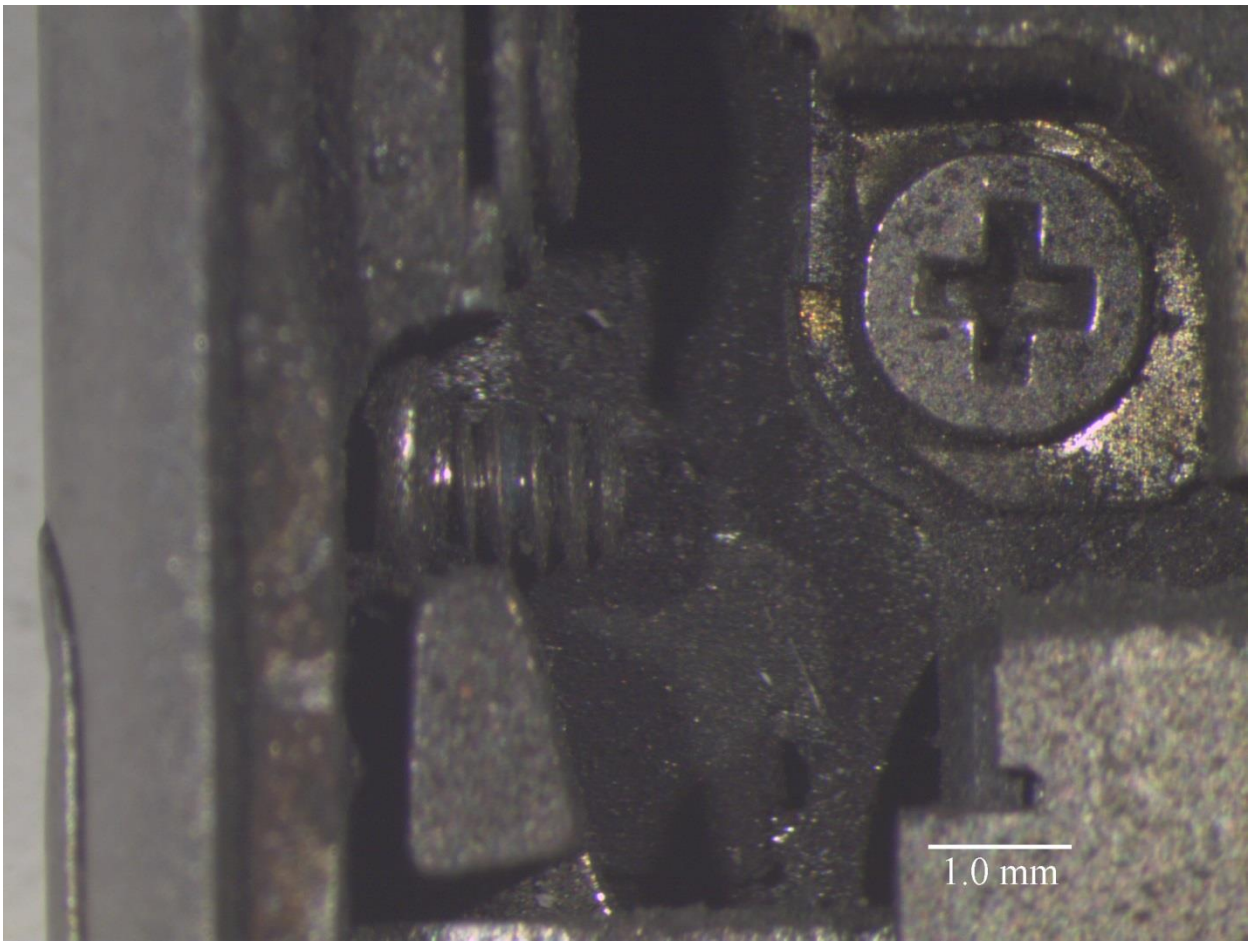

Figure 12 - Close up of loose screw

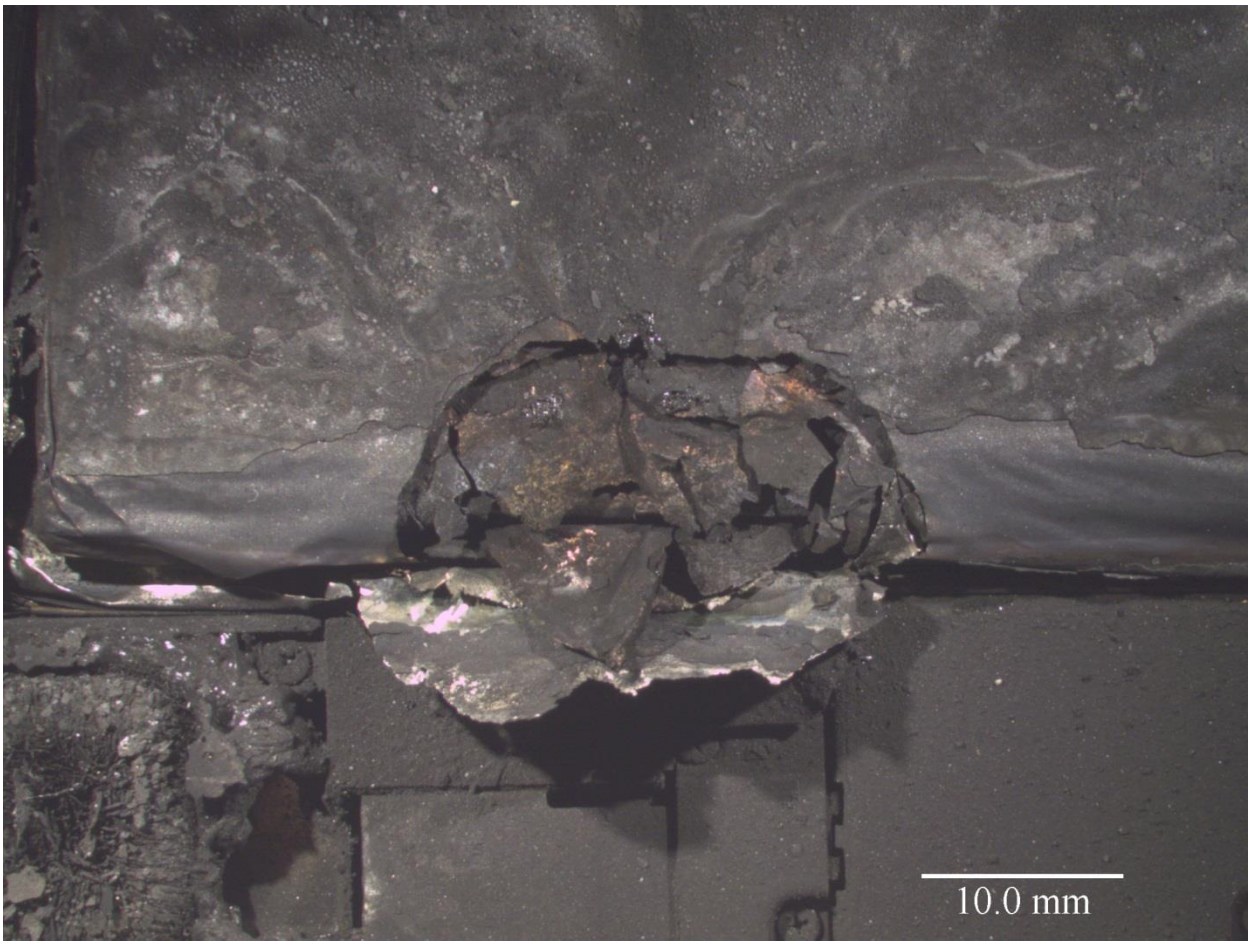

Figure 13 - Close up of battery cell rupture

F. ANALYSIS

Around 10:00 A.M. on July 17 2016, Ms. McCoy had recently woken up when she was sitting on her bed with her iPhone 6 Plus on the bed close to her when she heard a loud boom. She stood from the bed and, with her sister, saw the phone and surrounding bedding was on fire. They smothered the fire with clothing, removed the burning sheet with the phone in it, and threw it out of the window[3]. The burn damage included the bedding, the clothes, the mattress, the phone[4]. The lithium polymer battery in her iPhone 6 Plus had exploded causing Ms. McCoy burn injuries.

The remains of the incident battery were examined. The remains demonstrate that the casing of the battery was torn open and internal components were expelled (Figures 9, 13). The heat and force placed on the phone by the expanding battery cell caused the screen to crack separate from the case. The cause of the explosion is thermal runaway within the incident battery cell.

National Fire Protection Association (NFPA) 921 defines explosion:

> *"3.3.56 Explosion. The sudden conversion of potential energy (chemical or mechanical) into kinetic energy with the production and release of gases under pressure, or the release of gas under pressure. These high-pressure gases then do mechanical work such as moving, changing, or shattering nearby materials."*[5]

IEC 62133-2 Secondary Cells & Batteries Part 2 Lithium Systems and UL 1642 Lithium Batteries contain definitions of explosion that are relevant to lithium ion cells:

> *"3.12 explosion*
> *Failure that occurs when a cell container or battery case opens violently and major components are forcibly expelled."*[6]

> *"3.18 EXPLOSION – When the cell or battery contents are forcibly expelled and the cell or battery casing is torn or split into two or more pieces."*[7]

It is well established that lithium ion battery cells can explode and cause fire while undergoing thermal runaway.

> *"However, conventional lithium secondary batteries are susceptible to the high-risk of ignition/explosion arising from heating of batteries by IR-induced heat*

[3] McCoy Deposition page 29
[4] McCoy Deposition page 66.
[5] NFPA 921 2017 – Guide for Fire and Explosion Investigations, 3.3.56 Explosion
[6] International Electrotechnical Committee (IEC) 62133-2 Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 2 Lithium systems.
[7] Underwriters Laboratories (UL) 1642 2012 Lithium Batteries – 3.18 Explosion

generation when large amounts of electrical current flow within a short period of time due to various factors such as exposure to high temperatures, overcharge, external short-circuiting, nail penetration, localized crushing and the like. Elevation of the battery temperature results in facilitation of reaction between the electrolyte and electrodes. As a consequence, occurrence of reaction heat is additionally accompanied by elevation of the battery temperature which in turn further accelerates the reaction between the electrolyte and electrodes. Therefore, the temperature of the battery rises sharply, thereby further accelerating the reaction between the electrolyte and electrodes. Due to being caught in such self perpetuating cycle, thermal runaway, which causes sharp elevation in the battery temperature, occurs, and ignition of the battery may take place if the battery temperature rises over a specified range. In addition, the reaction between the electrolyte and electrodes leads to generation of gases which in turn results in increased internal pressure of the battery and consequently the battery undergoes explosion at pressure exceeding a predetermined range. As such, it can be said that the risk of ignition/explosion is the most fatal disadvantage of lithium secondary batteries."[8]

"1.3 These requirements are intended to reduce the risk of fire or explosion when lithium batteries are used in a product. The final acceptability of these batteries is dependent on their use in a complete product that complies with the requirements applicable to such product."[9]

The loss of battery cell material observed via radiography is most significant on the screen-facing side towards the internal electronics. This area is shown in figures 9 and 13. There is evidence of high heat on the mid plate, which is between the battery and the screen. The mid plate demonstrates a hole. While this part of the phone experienced high heat, the hole was not caused by the thermal runaway or external damage. The hole on the mid-plate is a part of the manufacturer's design. The damage pattern visible on the exterior of the screen is consistent with the battery cell rupture location, again indicating damage from an internal source. The rupture on the side of the battery is consistent with an object penetrating the battery cell casing.

The high heat of the battery caused the label of the battery to be partially transferred to the mid plate. The visible sections of the transferred label are consistent with an Apple manufactured battery cell. Apple has sample battery cells tested by an external testing organization for compliance with IEC 62133. This standard has requirements concerning venting:

"5.3 Venting

[8] United States Patent 7,625,669 – December 1, 2009 – LG Chem. LTD. – Lithium Secondary Battery Having Improved Stability to Overcharge – Column 1, Background of the Invention

[9] UL 1642 – Standard for Safety – Lithium Batteries – 2012; Scope

> *Battery cases and cells shall incorporate a pressure relief mechanism or shall be so constructed that they will relieve excessive internal pressure at a value and rate that will preclude rupture, explosion and self-ignition."*[10]

The sample battery cells for the iPhone 6 passed this section of the requirements. The damage observed on the battery cell is not indicative of the actuation of a pressure relief mechanism instead it is consistent with an object penetrating the battery cell casing causing internal short circuit, thermal runaway, and cell rupture.

The photographs and radiography provided by SEL (Apple document production) demonstrate that there were multiple internal screws missing from the incident phone. The following screws were not installed in the remains of the phone: (2) mid-plate attachment screws, (3) screen assembly screws, and (1) side button bracket screw. Evidence examination confirmed these screws were not found installed in the appropriate locations. There was a screw found loose on the side of the phone containing the electronics, near the SIM card slot. This screw or one of the other missing screws was the object that penetrated the battery cell causing short circuit and thermal runaway.

FedEx Supply performed the refurbishment of the incident phone including modification/replacement of the screen, back cover, battery, front camera, and charging port. To conduct this repair many internal screws would necessarily be removed. A proper repair would include replacing them to the correct location, securing the assemblies. The remains of the phone indicate that this did not occur, as several screws are documented to be missing and one remained loose within the phone. The only reasonable conclusion is that FedEx Supply failed to install all of the internal screws in the proper locations leaving a screw in between the battery and mid plate. The screw was pressing upon the battery cell and at the time of the incident the screw penetrated the battery cell casing and caused the cell to enter thermal runaway. FedEx Supply performed a defective refurbishment of the incident iPhone and this was a cause of the incident.

The phone was not altered or repaired while in the possession of Ms. McCoy[11]. The phone was not dropped, damaged[12], wet[13], or used with a third party charger[14]. After the incident, Ms. McCoy has no knowledge of any attempts to disassemble or investigate the incident phone.[15]

[10] International Electrotechnical Commission 62133 Secondary Cells and batteries containing alkaline or other non-acid electrolytes – 2012 – 5.3 Venting
[11] McCoy Deposition page 47
[12] McCoy Deposition page 138
[13] McCoy Deposition page 55
[14] McCoy Deposition page 51
[15] McCoy Deposition page 91

G. FINDINGS

Within the bounds of reasonable engineering certainty, and subject to change if additional information becomes available, it is my professional opinion that:

1. The lithium polymer battery within Ishynique McCoy's Apple iPhone 6 Plus went into thermal runaway causing her burn injuries.
2. The cause of the thermal runaway was penetration of the battery cell casing by a misplaced screw left in the phone after defective refurbishment as performed by FedEx Supply Chain.

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